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APPEAL BRIEF

Atty. Docket No. 18703-505

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re Application	)	
	)	Confirmation No.: 4351
Inventors: Peng Chang et al.	)	
	)	Art Unit: 2624
Application No.: 10/766,976	)	
	)	Examiner: BADII, Behrang
Filed: January 29, 2004	)	
	)	
Title: Stereo-Vision Based Imminent Collision Detection	)	Date: October 17, 2008

APPELLANTS' BRIEF PURSUANT TO 37 C.F.R. § 41.37

MAIL STOP APPEAL BRIEF - PATENTS
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Appellants submit this brief in accordance with the provisions of 37 C.F.R. § 41.37 in response to the Non-Final Rejection mailed December 17, 2007. Appellants' Notice of Appeal was filed on April 17, 2008. This Appeal Brief is being filed with a four month extension of time fee of $1,730.00. Please charge said fee to Deposit account No. 501358.

I. REAL PARTIES IN INTEREST

The real parties in interest are SARNOFF CORPORATION (Assignee) and AUTOLIV ELECTRONICS by virtue of an assignment executed by the inventors (Appellants) to SARNOFF CORPORATION AND AUTOLIV ELECTRONIS (recorded by the Assignment Branch of the U.S. Patent and Trademark Office on January 29, 2004 at Reel/Frame 014944/0602.

II. RELATED APPEALS AND INTERFERENCES

None.

III. STATUS OF CLAIMS

In the application under appeal, claims 1-28 are pending. Claims 1-5, 7, 13-14, 16 and 20-22 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Awe Franke et al, Autonomous Driving Goes Downtown, I.E.E.E. Intelligent Systems, pages: 40-48, 1998 (hereinafter "*Franke*"). Claims 6, 15 and 23 stand rejected as being unpatentable over *Franke* in view of Ming Yang et al., Vision-based Real-time Obstacles Detection and Tracking for Autonomous Vehicle Guidance, Real-time Imaging VI, Proceedings of SPIE Vol. 4666, pages 65-74, 2002 (hereinafter "*Yang*"). Claims 8-12, 17-19, 24-26, and 27-28 are objected to as being dependent upon a rejected based claim, but have been deemed allowable if rewritten in independent form including all the limitations of the base claim and any intervening claims. The rejection of claims 1-7, 13-16 and 23 are appealed.

IV. STATUS OF AMENDMENTS

Appellants have submitted no amendments after the non-final rejection. All amendments prior to the close of prosecution on the merits have been entered.

V. SUMMARY OF CLAIMED SUBJECT MATTER

Independent claim 1 recites a method of detecting an imminent collision. The method includes capturing and preprocessing imagery of a scene proximate a platform. Capturing and preprocessing imagery of a scene proximate a platform is described in the specification as filed at least at paragraph 24 and in Figure 3. The method further includes producing from the imagery a depth map. Producing a depth map from the imagery is described in the specification as filed at least at paragraph 24 and in Figure 3. The method further includes tessellating the depth map into a number of patches and selecting a plurality of the patches of the depth map for processing. Tessellating the depth map into a number of patches is described in the specification as filed at least at paragraph 30 and in Figure 6 and selecting a plurality of the patches of the depth map for processing is described in the specification as filed at least at paragraph 32 and in Figure 7. The processing includes classifying the selected plurality of patches of the depth map into a plurality of classes. Processing including classifying the selected plurality of patches of the depth map into a plurality of classes is described in the specification as filed at least at paragraph 30 and in Figure 6. The method further includes detecting a potential threat in the tessellated depth map during the processing of the selected plurality of the patches. Detecting a potential threat in the tessellated depth map during the processing of the selected plurality of the patches is described in the specification as filed at least at paragraphs 30 and 44 and in Figure 7. The method further includes estimating the size of the detected potential threat. Estimating the size of the detected potential threat is described in the specification as filed at least at paragraphs 26 and 45 and in Figure 4. The method further includes estimating the position of the detected

potential threat. Estimating the position of the detected potential threat is described in the specification as filed at least at paragraphs 26 and 45 and in Figure 4. The method further includes estimating the velocity of the detected potential threat. Estimating the velocity of the detected potential threat is described in paragraphs 26 and 46 and in Figure 4. The method further includes performing a trajectory analysis of the detected potential threat using the estimated position and the estimated velocity. Performing a trajectory analysis of the detected potential threat is described in the specification as filed at least at paragraph 28 and in Figure 4. The method further includes performing a collision prediction based on the trajectory analysis. Performing a collision prediction based on the trajectory analysis is described in the specification as filed at least at paragraph 28 and in Figure 4.

Independent claim 13 recites a collision detection system. The system includes a stereo camera pair for providing imagery of a scene proximate a platform. The stereo camera pair for providing imagery of a scene proximate a platform is described in the specification at least at paragraphs 22 and 24 and in Figures 2 and 3, references 200 and 202. The system further includes a stereo image preprocessor for preprocessing the imagery. The stereo image preprocessor for preprocessing the imagery is described at least at paragraph 24 and in Figure 3, reference 300. The system further includes a depth map generator for producing a depth map from the preprocessed imagery. The depth map generator is described in the specification at least at paragraph 24 and in Figure 3, reference 302. The system further includes a collision detector for tessellating the depth map into a number of patches, selecting a plurality of the patches of the depth map for processing. The collision detector for tessellating a depth map into a number of patches, selecting a plurality of the patches of the depth map for processing is described in the specification at least at paragraphs 24, 30 and 32 and in Figure 3, reference 304. The processing includes classifying the selected plurality of patches of the depth map into a plurality of classes. The processing including classifying the selected plurality of patches of the depth map into a plurality of classes is described in the specification at least at paragraph 30 and in Figure 6. The processing also includes detecting a potential threat in the tessellated depth map

during the processing of the selected plurality of the patches. The processing including detecting a potential threat in the tessellated depth map during the processing of the selected plurality of the patches is described in the specification at least at paragraphs 30 and 44 and in Figure 7. The collision detector estimates size, position, and velocity of the detected potential threat. The collision detector performs a trajectory analysis of the detected potential threat using the estimated position and the estimated velocity. The collision detector predicts a collision based on the trajectory analysis. The collision detector determines if a collision is imminent based on the collision prediction and on the estimated size. The collision detector that estimates size, position, and velocity of the detected potential threat, performs a trajectory analysis of the detected potential threat using the estimated position and the estimated velocity, predicts a collision based on the trajectory analysis and determines if a collision is imminent based on the collision prediction and on the estimated size is described in the specification at least at Abstract and paragraphs 20, 25, 26, 28 and 46 and in Figure 4.

Independent claim 20 recites a computer readable medium having stored thereon a plurality of instructions, the plurality of instruction including instructions which, when executed by a processor causes the processor to perform steps. The computer readable medium having stored thereon a plurality of instructions, the plurality of instruction instructions which, when executed by a processor causes the processor to perform steps is described in the specification as filed at least at paragraph 23 and in Figures 1 and 2, reference 108. The steps include capturing and preprocessing an imagery of a scene proximate a platform. Capturing and preprocessing an imagery of a scene proximate a platform is described in the specification as filed at least at paragraph 24 and in Figure 3. The steps further include producing from the imagery a depth map. Producing from the imagery a depth map is described in the specification as filed at least at paragraph 24 and in Figure 3. The steps further include tessellating the depth map into a number of patches. Tessellating the depth map into a number of patches is described in the specification as filed at least at paragraph 30 and in Figure 6. The steps further include selecting a plurality of the patches of the depth map for processing. Selecting a plurality of the patches of the depth

map for processing is described in the specification as filed at least at paragraph 32 and in Figure 7. The processing includes classifying the selected plurality of patches of the depth map into a plurality of classes. Processing including classifying the selected plurality of patches of the depth map into a plurality of classes is described in the specification as filed at least at paragraph 30 and in Figure 6. The steps further include detecting a potential threat in the tessellated depth map during the processing of the selected plurality of the patches. Detecting a potential threat in the tessellated depth map during the processing of the selected plurality of the patches is described in the specification as filed at least at paragraphs 30 and 44 and in Figure 7. The steps further include estimating the size of the detected potential threat. Estimating the size of the detected potential threat is described in the specification as filed at least at paragraphs 26 and 45 and in Figure 4. The steps further include estimating the position of the detected potential threat. Estimating the position of the detected potential threat is described in the specification as filed at least at paragraphs 26 and 45 and in Figure 4. The steps further include estimating the velocity of the detected potential threat. Estimating the velocity of the detected potential threat is described in the specification as filed at least at paragraphs 26 and 46 and in Figure 4. The steps further include performing a trajectory analysis of the detected potential threat using the estimated position and the estimated velocity. Performing a trajectory analysis of the detected potential threat using the estimated position and the estimated velocity is described in the specification as filed at least at paragraph 28 and in Figure 4. The steps further include performing a collision prediction based on the trajectory analysis. Performing a collision prediction based on the trajectory analysis is described in the specification as filed at least at paragraph 28 and in Figure 4.

References in this brief to supporting portions of the specification and drawings are given to provide exemplary embodiments, not to provide limitations to the claims.

VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

Appellants respectfully request that the Board of Patent Appeals and Interferences review the following grounds of rejection on appeal:

1. Whether claims 1-5, 7, 13-14, 16, and 20-22 are patentable under 35 U.S.C. § 102(b) over *Franke.*

2. Whether claims 6, 15 and 23 are patentable under 35 U.S.C. § 103(a) over *Franke* in view of *Yang.*

VII. ARGUMENT

Appellants respectfully submit that claims 1-5, 7, 13-14, 16, and 20-22 are patentable over the prior art of record.

Claims 1-5, 7, 13-14, 16 and 20-22 Are Patentable over Franke

Independent claims 1, 13 and 20 are rejected under 35 U.S.C. § 102(b) as being anticipated by *Franke*. Appellants respectfully disagree.

Appellants assert that independent claims 1, 13 and 20 are patentable over *Franke* because Appellants contend that *Franke* discloses a different method, system and computer readable medium, respectively, from what is claimed in claims 1, 13 and 20. Appellants further contend that the Examiner, when rejecting claims 1, 13 and 20 under 35 U.S.C. § 102(b), failed to give weight to express limitations of the claims that are not disclosed, taught or suggested by *Franke*. "A prior art reference anticipates a claim only if the reference discloses, either expressly or inherently, every limitation of the claim.... Absence from the reference of any claimed element negates anticipation." Rowe v. Dror, 112 F3.3d 473, 478, 42 USPQ2d 1550 Fed. Cir. (1997) (internal citations omitted). Franke does not disclose, teach or suggest all the limitations

of claim 1. In general, Appellants contend that *Franke* does not disclose a method of detecting an imminent collision claimed in claim 1. Illustrative of this is that *Franke* does not disclose the method of detecting an imminent collision that includes classifying a selected plurality of patches of the depth map into a plurality of classes as claimed in claim 1.

Firstly, Franke does not teach <u>classifying</u> <u>patches</u> of a <u>depth</u> <u>map</u>. As is known to those of skill in the art, a depth map is a 2-dimensional array of values (sometimes also called a depth image, range map or range image), each point of which represents the depth to a point in a scene. Also, as claimed, the depth map is tessellated into a plurality of patches, and the patches are then classified. As is known to those of skill in the art, to tessellate is to form of small squares or blocks, as floors or pavements or to form or arrange in a checkered or mosaic pattern. *Franke* does not describe classifying portions of a depth map, but instead, describes classifying pixels of an <u>image</u>.

Secondly, as claimed in the present application, a <u>selected</u> number of the patches of a depth map are classified into a plurality of classes. *Franke* does not describe classifying selected portions, but instead teaches classifying a whole image.

Thus, Appellants assert that *Franke* fails to disclose all the elements of claim 1 and Appellants further assert that the Examiner failed to properly consider this claim limitation in his rejection. For example*:*

<u>**Classifying** a plurality of **patches** of the **depth map**:</u>

The Examiner contends that *Franke* discloses classifying a plurality of patches of a depth map into a plurality of classes. For this, the Examiner points to *Franke*, which describes that a system can "detect and classify different additional traffic participants, such as bicyclists or pedestrians" (*Franke* at page 41, column 1), that a "polynomial classifier subsequently classifies detected lane boundaries such as curbs, markings or [a] clutter" (*Franke* at page 43, column 1), and "[t]he classifications stages [involve] color, shape and pixel values" (*Franke* at page 44,

column 2). In none of these sections, however, does *Franke* disclose classifying **patches of a depth map** into a plurality of classes as will be described in greater detail below.

When *Franke* describes a system to "detect and classify different additional traffic participants, such as bicyclists or pedestrians;" *Franke* is describing tasks to be performed to build a system without any teaching or suggestion of how to implement this task. This portion of *Franke* does not describe classifying patches of a depth map. When *Franke* describes that a "polynomial classifier subsequently classifies detected lane boundaries such as curbs, markings or clutter," *Franke* is simply disclosing using a polynomial method to classify the features detected on a road which includes identifying the target types in the region of interest and rejecting any clutter and background. As known to those of skill in the art, a polynomial classifier is defined as a method of grouping objects into one or more groups, or classes, based on the best-fit of a parameterized polynomial equation to the observed data. Again, this portion of *Franke* involves classifying polynomials of an image, not a depth map. Clearly, the polynomial classifier as disclosed in *Franke* fails to teach or suggest **classifying patches** of a **depth map** into a plurality of classes. Franke also describes that "classification, is done with an RBF classifier in [a] multi stage process," and that "a color-normalized pictograph [is] extracted from the original image," wherein the "classifications stages involve color, shape and pixel values." As known to those of skill in the art, a RBF classifier is a radial basis function classifier which is defined as a real-valued function whose value depends on the distance from an origin. The RBF classifier as disclosed in *Franke* classifies a pictograph from an original image. So, again, *Franke* describes classifying a pictograph from an image, but not classifying **patches** of a **depth map**. Thus, *Franke* fails to teach or suggest any type of classifying of the depth map including classifying patches of a depth map. Therefore, the cited portions of *Franke* cannot support the Examiner's rejection of claim 1.

On the contrary, as discussed above, *Franke* does not describe classifying patches of a depth map, but instead teaches a system in which classification is performed on an entire image.

Note that on page 41, column 2, *Franke* teaches that a "feature-based approach classifies each pixel according to gray values of its four direct neighbors." Thus, *Franke* teaches classification of an entire image of the scene (figure 1 of *Franke*) by classifying each pixel in the image. Whereas, in the present application, a plurality of **patches** of the **depth map** are classified, as recited in amended independent claim 1, 13 and 20. Further, these images of *Franke* are stereo images and not a depth map as claimed in the present invention. See page 41, column 2 and Figure 1 of *Franke*. As is known to those of skill in the art, a stereo image is a pair of images taken of a single scene by two cameras, whose relative orientation is typically pre-determined by calibration. One skilled in the art understands that the stereo image is not same as the depth map, which, as discussed above, is a 2-dimensional array of values (sometimes also called a depth image, range map or range image), each point of which represents to a point in a scene. While *Franke* does separately describe a depth map, *Franke* does not describe classifying patches of a depth map. Instead, after classification of the stereo image, *Franke* describes extracting structures from the image to recognize road boundaries and then removing all features on the road plane to generate a 2-dimensional depth map containing the remaining features including the objects that are subsequently tracked. (See page 41, columns 2 and 3 and page 42, column 1 of *Franke*). Thus, *Franke* describes classifying an image, removing objects from the image, and then creating a depth map, but *Franke* does not describe classifying portions of a depth map. Clearly, *Franke* does not describe any classifying of the depth map, let alone classifying a plurality of patches of the depth map.

Classifying a **selected** plurality of patches of the depth map into a plurality of classes:

In the present application, only parts (selected patches) of the depth map are classified, not an entire depth map. Support for this is provided in paragraphs 30 and 32 and Figures 6 and 7 of the present application. On the contrary, *Franke* teaches a system in which classification is performed on an entire image. Note that on page 41, column 2, *Franke* teaches that a "feature-

based approach classifies each pixel according to gray values of its four direct neighbors." Thus, *Franke* teaches classification of an entire image of the scene (figure 1 of *Franke*) by classifying each pixel in the image. Whereas, in the present application, a **selected** plurality of patches of the depth map are classified, as recited in independent claims 1, 13 and 20. Thus, as claimed in the present application, only selected parts of a depth map are classified. Support for this is provided in paragraphs 30 and 32 and Figures 6 and 7 of the present application. For example, at step 706 in Figure 7, a determination is made as to whether a patch is dense enough to be used for processing and only those patches with sufficient density are selected for processing.

Therefore, the cited disclosure of *Franke* fails to meet the MPEP's requirement that "[a] claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." Verdegaal Bros., Inc. v. Union Oil Co., 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987) (Emphasis Added).

In the system and method of the present invention as claimed, the depth map is first produced, which is tessellated into patches and then further classified to detect a potential threat. In contrast, Franke describes an application that uses a depth map and, also describes a separate and distinct application that employs object classification. Thus, *Franke* describes two separate applications, which are independent of each other. First is the **stereo-based obstacle detection and tracking** application and second is the **object recognition** application. With regard to the first system, on page 40, column 2, *Franke* describes a system that "includes stereo vision for depth-based obstacle detection and tracking and a framework for monocular detection and recognition of relevant objects." Also, on page 46, column 2 to column 3, *Franke* recites two methods of detection as "[c]olor clustering on monocular images in a combined color and position feature space" and "3D segmentation on stereo vision." As is known to those of skill in the art, a monocular image is one image taken of a single scene by a single camera. This detection of the monocular image does not provide the depth perception of the image. One skilled in the art understands that a monocular image is not same as the stereo image, which, as discussed above, is a pair of images taken of a single scene by two cameras, whose relative

orientation is typically pre-determined by calibration. This clearly indicates that the **object recognition** of *Franke* does not utilize the stereo depth map of **obstacle detection** since it is monocular. So, the steps of **object recognition** do not occur subsequent to the disparity image created for **obstacle detection and tracking**. Therefore, while *Franke* does describe both object detection and the use of a depth map, these features are not described as being part of the same system, but instead, are described as being separate and distinct. Thus, the depth map described by *Franke* is not "arranged as in that claim" as recited by claim 1 of the present application. Furthermore, "Anticipation under Section 102 requires the presence in a single prior art disclosure of all elements of a claimed invention arranged as in that claim" quoting <u>Connell vs. Sears, Roebuck & Co</u>. 772 F.2d 1542, 1548, 220 USPQ 193, 198 (Fed. Cir. 1983).

The above discussion shows features of claim 1 are not disclosed or suggested by *Franke* Thus, for <u>any</u> <u>one</u> of the several reasons discussed above, it is believed that *Franke* fails to anticipate the invention of claim 1 under 35 USC § 102(b), and that the rejection should be reversed. Such action is respectfully requested. Appellants further believe that the rejection of dependent claims 2-5 should be reversed at least because such claims depend directly or indirectly from such parent claim 1, which is believed patentable.

Independent claims 13 and 20 were rejected based on an application of *Franke* in a way that is believed incorrect as indicated above with respect to claim 1. Thus, at least for the reasons set forth above, Appellants believe that the rejection of such claims should be reversed. Appellants further believe that the rejection of dependent claims 14, 16-19 and 21-22 should be reversed at least because such claims depend directly or indirectly from such parent claims 13 and 20, which are believed patentable.

Claims 6, 15 and 23 Are Patentable Over *Franke* and *Yang*

Claims 6, 15 and 23 are rejected under 35 U.S.C. § 103(a) as being unpatentable over *Franke* as applied to claims 1, 13 and 20 above, and further in view of *Yang*. Appellants respectfully disagree.

The rejection of such claims was made based on an application of *Franke*, plus an additional application of *Yang* for elements that the Examiner recognizes are not disclosed by *Franke*. Appellants believe that the application of *Franke* to such claims was made in a way that is incorrect as indicated above with respect to claims 1, 13 and 20. Thus, there are still elements of the claims that are not taught or suggested by the references, even if *Franke* were to be combined with *Yang*. Therefore, it is believed that the rejection of such claims 6, 15 and 23 under 35 U.S.C. § 103(a) should be reversed, and such action is respectfully requested.

CONCLUSION

For the reasons stated above, claims 1-7, 13-16 and 20-23 are patentable over the prior art of record, and the rejections of those claims under 35 U.S.C. § 102(b) and 35 U.S.C. § 103(a) are improper and should be withdrawn. Appellants respectfully ask the Board to reverse the Examiner's rejections with instructions to allow the claims.

The USPTO is directed and authorized to charge all required fees to Deposit Account No. 501358. Appellant's undersigned agent may be reached by telephone at (973) 597-2500. All correspondence should continue to be directed to our address listed below.

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VIII. CLAIMS APPENDIX

1. (Previously Presented) A method of detecting an imminent collision comprising the steps of:

capturing and preprocessing imagery of a scene proximate a platform;

producing from the imagery a depth map;

tessellating the depth map into a number of patches and selecting a plurality of the patches of the depth map for processing, wherein said processing comprise classifying the selected plurality of patches of the depth map into a plurality of classes;

detecting a potential threat in the tessellated depth map during the processing of the selected plurality of the patches;

estimating the size of the detected potential threat;

estimating the position of the detected potential threat;

estimating the velocity of the detected potential threat;

performing a trajectory analysis of the detected potential threat using the estimated position and the estimated velocity; and

performing a collision prediction based on the trajectory analysis.

2. (Original) The method of claim 1, further including determining if a collision is imminent based on the collision prediction and on the estimated size of the potential threat.

3. (Original) The method of claim 1, further including filtering the estimated position and filtering the estimated velocity before performing trajectory analysis.

4. (Previously Presented) The method of claim 3 wherein the filtering includes Kalman filtering.

5. (Original) The method of claim 1 wherein estimating the velocity of the detected potential threat includes the step of identifying 2-dimensional feature correspondences from imagery produced in different time frames.

6. (Previously Presented) The method of claim 5 wherein estimating the velocity of the detected potential threat further includes the step of obtaining 3D correspondences from the 2-dimensional feature correspondences and from the depth map.

7. (Original) The method of claim 6 wherein estimating the velocity of the detected potential threat further includes the step of estimating velocity using Random Sample Consensus.

8. (Previously Presented) The method of claim 1 wherein said processing the selected plurality of patches further comprises:

fitting a plane to each patch of said selected plurality of the patches;

obtaining a normal vector to each plane,

said plurality of classes comprise one class representing the patches that are likely to represent a potential threat, another class representing the patches that possibly represent a potential threat, and another class representing the patches that are unlikely to represent a potential threat, wherein said classifying is based on the obtained normal vector for each patch and on 3D positions of each patch.

9. (Original) The method of claim 8 further including the step of grouping patches that are likely to represent a potential threat together.

10. (Original) The method of claim 9 further including the step of creating a bounding box that represents a potential threat, wherein the bounding box is created in accord with the grouping of patches.

11. (Previously Presented) The method of claim 8 wherein detecting a potential threat in the tessellated depth map includes the steps of moving each patch after local tessellation to find the region of maximum stereo density near the original patch location, of discarding a patch if the region of maximum stereo density does not meet a predetermined criterion, and adding the patch to the plurality of the patches if the patch density meets the predetermined criterion.

12. (Original) The method of claim 8 wherein obtaining a normal vector includes the steps of calculating the third Eigen-vector of a matrix of patch values using a singular valued decomposition of the matrix, and then estimating the normal vector as the third Eigen-vector.

13. (Previously Presented) A collision detection system, comprising:

a stereo camera pair for providing imagery of a scene proximate a platform;

a stereo image preprocessor for preprocessing said imagery;

a depth map generator for producing a depth map from said preprocessed imagery; and

a collision detector for tessellating the depth map into a number of patches, selecting a plurality of the patches of the depth map for processing, wherein said processing comprise classifying the selected plurality of patches of the depth map into a plurality of classes; detecting a potential threat in said tessellated depth map during the processing of the selected plurality of the patches,

wherein said collision detector estimates size, position, and velocity of said detected potential threat;

wherein said collision detector performs a trajectory analysis of said detected potential threat using said estimated position and said estimated velocity;

wherein said collision detector predicts a collision based on said trajectory analysis; and

wherein said collision detector determines if a collision is imminent based on said collision prediction and on said estimated size.

14. (Original) The system of claim 13, wherein said collision detector includes a filter for filtering image noise and outliers from said estimated position and from said estimated velocity before performing trajectory analysis.

15. (Previously Presented) The system of claim 13 wherein said collision detector estimates said by identifying 2-dimensional feature correspondences from imagery produced in different time frames and then obtains 3D correspondences of said 2-dimensional feature correspondences using said depth map.

16. (Original) The system of claim 13, further including a host vehicle, wherein said stereo camera pair is mounted in fixed locations relative to said host vehicle.

17. (Previously Presented) The system of claim 13 wherein said collision detector detects the potential threat in the tessellated depth map by:

fitting a plane to the selected plurality of said patches;

obtaining normal vectors to said selected plurality of patches,

wherein said classifying is based on said normal vector for that patch and on 3D positions of each patch, as likely to represent a potential threat, as possibly representing a potential threat, or as being unlikely to represent a potential threat; and

grouping patches that are likely to represent a potential threat together; and forming a bounding box around said potential threat based on said patch groupings.

18. (Previously Presented) The system of claim 17 wherein said collision detector searches each patch after tessellation to find a densest part of said patch, discards said patch if said patch density does not meet a predetermined criterion, and adds said patch to said plurality of patches if said patch density meets said predetermined criterion.

19. (Original) The system of claim 17 wherein obtaining normal vectors includes the steps of calculating for each patch a third Eigen-vector of a matrix of patch values using a singular valued decomposition of said matrix, and then estimating said normal vector as said third Eigen-vector.

20. (Previously Presented) A computer readable medium having stored thereon a plurality of instructions, the plurality of instruction including instructions which, when executed by a processor causes the processor to perform the steps comprising:

capturing and preprocessing an imagery of a scene proximate a platform;

producing from the imagery a depth map;

tessellating the depth map into a number of patches and selecting a plurality of the patches of the depth map for processing, wherein said processing comprise classifying the selected plurality of patches of the depth map into a plurality of classes;

detecting a potential threat in the tessellated depth map during the processing of the selected plurality of the patches;

estimating the size of the detected potential threat;

estimating the position of the detected potential threat;

estimating the velocity of the detected potential threat;

performing a trajectory analysis of the detected potential threat using the estimated position and the estimated velocity; and

performing a collision prediction based on the trajectory analysis.

21. (Original) The computer readable medium of claim 20 that further causes the processor to filter the estimated position and the estimated velocity before performing trajectory analysis.

22. (Original) The computer readable medium of claim 20 that further causes the processor to determine the velocity by identifying 2-dimensional feature correspondences from imagery produced in different time frames.

23. (Previously Presented) The computer readable medium of claim 22 that further causes the processor to determine velocity by obtaining 3D correspondences from the 2-dimensional feature correspondences and from the depth map.

24. (Previously Presented) The computer readable medium of claim 20 that further causes the processor to detect the potential threat by the steps of:

fitting a plane to each patch of the selected plurality of patches;

obtaining a normal vector to each plane,

wherein said classifying is based on said normal vector for that patch and on 3D positions of each patch, as likely to represent a potential threat, as possibly representing a potential threat, or as being unlikely to represent a potential threat.

25. (Original) The computer readable medium of claim 24 that further controls a computer to group patches together that are likely to represent said potential threat.

26. (Original) The computer readable medium of claim 25 that further causes the processor to create a bounding box that represents the potential threat, wherein the bounding box is created in accord with the patch groupings.

27. (Previously Presented) The computer readable medium of claim 20 that further causes the processor to detect a potential threat in said tessellated depth map by the steps of moving each patch after local tessellation to find the region of maximum stereo density near the original patch location, discarding said patch if the region of maximum stereo density does not meet a predetermined criterion, and adding said patch to said plurality of patches if said patch density meets said predetermined criterion.

28. (Original) The computer readable medium of claim 20 that further causes the processor to obtain normal vectors by the steps of calculating for each patch a third Eigen-vector of a matrix of patch values using a singular valued decomposition of said matrix, and then estimating said normal vector as said third Eigen-vector.

IX. EVIDENCE APPENDIX

Awe Franke et al, Autonomous Driving Goes Downtown, I.E.E.E. Intelligent Systems, pages: 40-48 1998 (*Franke*) cited by Examiner in office actions mailed on 02/28/2005, 09/08/05, 05/18/06, 11/22/06, 03/08/07, 07/09/07 and on 12/17/07.

Ming Yang et al, Vision-based Real-time Obstacles Detection and Tracking for Autonomous Vehicle Guidance, Real-time Imaging VI, Proceedings of SPIE Vol. 4666, pages 65-74, 2002 (*Yang*) cited by Examiner in office actions mailed on 02/28/2005, 09/08/05, 05/18/06, 11/22/06, 03/08/07, 07/09/07 and on 12/17/07.

X. RELATED PROCEEDINGS APPENDIX

None.